Solar Energy

The Natural Solution for Energy and Environment

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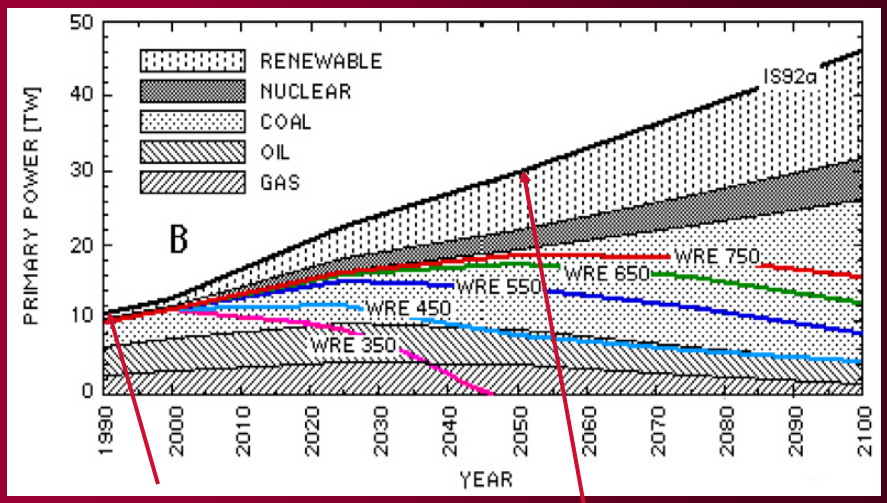
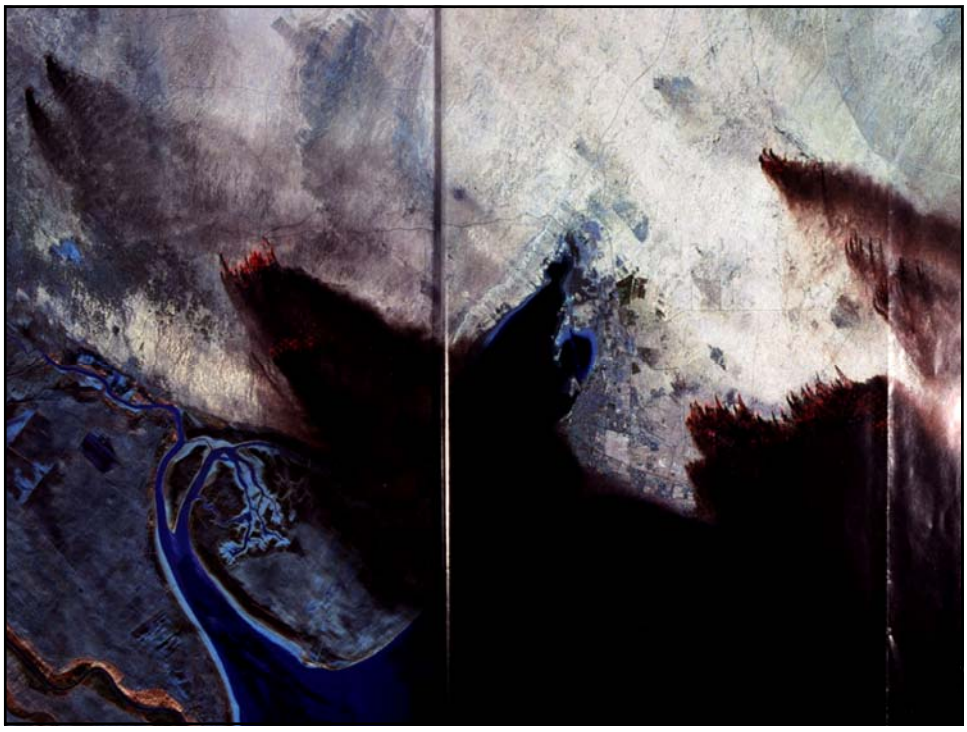
Total Primary Power vs Year



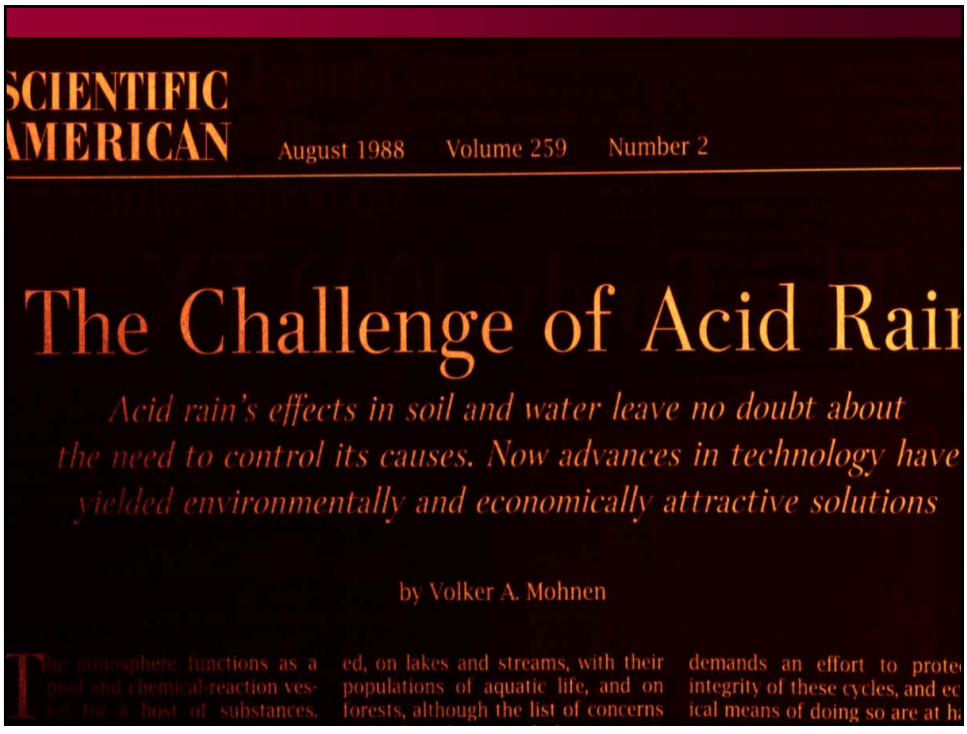
1990: 12 TW 2050: 28 TW

ENERGY DEMAND 1999

	WORLD	U.S.A
Energy/year	382 Quads	97 Quads
Fossil Fuels	85%	84%
Oil	40%	39%
Coal	22%	22%
Natural Gas	23%	23%
Nuclear	7%	8%
Renewable	8%	8%




U.S.News
& WORLD REPORT
JUNE 12, 1989
$1.95
DIRTY AIR
The losing battle to clean up the atmosphere.
What pollution does to your health


SCIENTIFIC
AMERICAN
August 1988 Volume 259 Number 2
The Challenge of Acid Rai
Acid rain's effects in soil and water leave no doubt about the need to control its causes. Now advances in technology have yielded environmentally and economically attractive solutions
by Volker A. Mohnen
The atmosphere functions as a pool and chemical-reaction ves- sel for a host of substances.
ed, on lakes and streams, with their populations of aquatic life, and on forests, although the list of concerns
demands an effort to prote integrity of these cycles, and ec ical means of doing so are at h

HIDDEN MENACE: Invisible CO_2 emitted along with smoke from this Arizona copper smelter is warming up the air

GLOBAL WARMING

Feeling the Heat

Nation

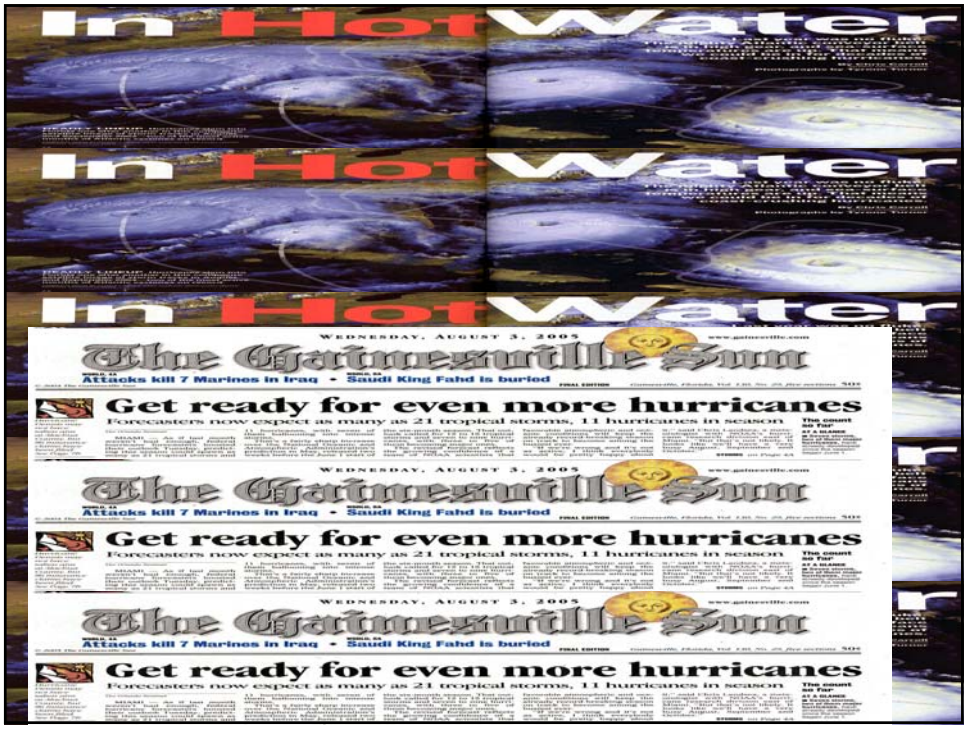
Is the Earth Warming Up?

Yes, say scientists, but that may not explain this year's heat wave

The Great Plains has become a dust bowl, and people are moving north into Canada's uplands to seek work. Even in Alaska, changing ocean currents are boosting the fish catch. New York is sweltering in 95° weather that began in June and will continue through Labor Day. In the Southeast the hot spell started six weeks earlier . . .

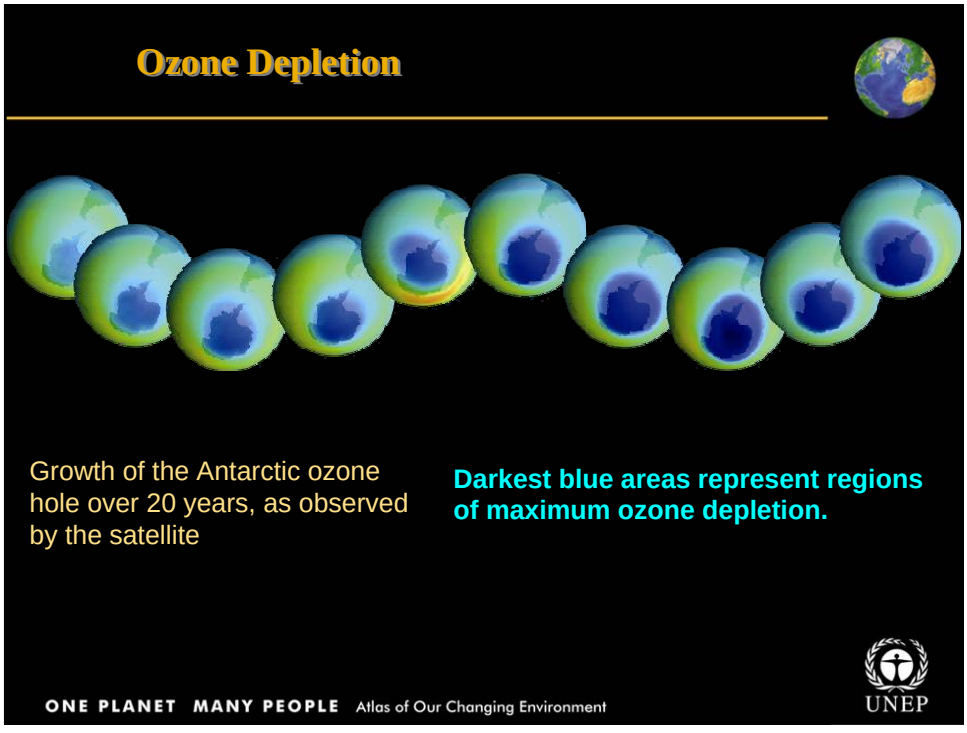
That picture of the future is all too familiar to many meteorologists. To some, it makes the drought that is crippling the nation's midsection seem an ominous harbinger of things to come. Because of

around the world. The data showed tha temperatures over the past century ha increased in winter more than in summe and that areas in high latitudes like Pari and New York had warmed up more tha regions near the equator. That was consis tent with computer models. "These are al expected signatures of the greenhouse ef fect," Hansen said. Still, he and othe leading scientists warned against con cluding that the greenhouse effect is di rectly responsible for the heat wave that i parching areas of the U.S. "Why didn't w have a drought last summer?" he asks "You can only say that the probability o drought is increased by the greenhou


In Hot Water
In Hot Water
In Hot Water
WEDNESDAY, AUGUST 3, 2005
The Gainesville Sun
Attacks kill 7 Marines in Iraq • Saudi King Fahd is buried
Get ready for even more hurricanes
Forecasters now expect as many as 21 tropical storms, 11 hurricanes in season


Hurricane Tracks
When sea-surface temperatures were cooler (1985-1994)
Category 3-5
Lower-intensity storm
Sea-surface Temperatures
1944-2004
1985-1994
1995-2004
Now that they're warmer (1995-2004)
RELATIVE CALM GIVES WAY TO FRENZY Two ten-year periods of hurricane activity show that from 1985 to 1994, when sea-surface temperatures were low, there were half as many major hurricanes as during the most recent decade, when temperatures rose by one to two degrees F—the result of changes in ocean currents that cycle water and heat between the far northern Atlantic and the tropics. Frequency of major hurricanes rises and falls on a multidecadal time frame (graph at left) that scientists are still trying to understand.


July 26 --- Sudden Downpour Breaks All Records in Mumbai
HIGH TIDE ON
THE TRACKS
1:30 PM
DOMBIVLI STATION


Ozone Depletion
Growth of the Antarctic ozone hole over 20 years, as observed by the satellite
Darkest blue areas represent regions of maximum ozone depletion.
ONE PLANET MANY PEOPLE Atlas of Our Changing Environment
UNEP


LANET OF THE YEAR
What On
EARTH
Are We Doing?

RENEWABLE ENERGY

Direct and Indirect Forms of Solar Energy

2003 Capacity (MW)		Growth 2000-2003
World	39,151	
OECD	35,314	32.33
OECD (Europe)	28,236	30.4
Germany	14,609	34.1
Spain	5,945	35.3
USA	5,995	37.7

BIOMASS

BIOGAS, ETHANOL, METHANOL, HYDROGEN

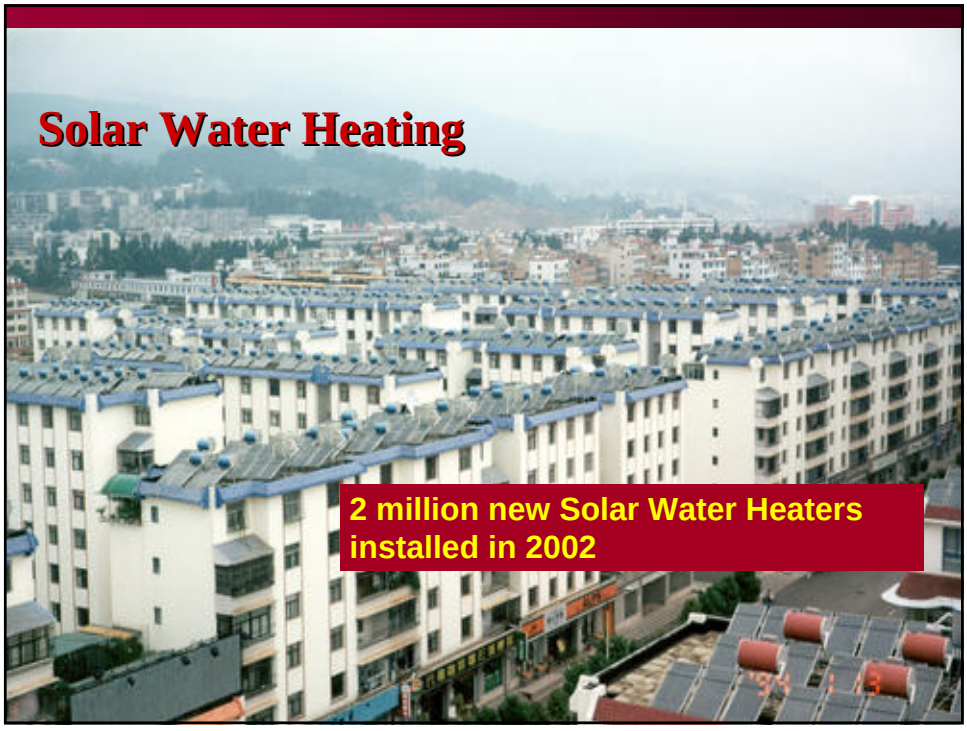
FOR

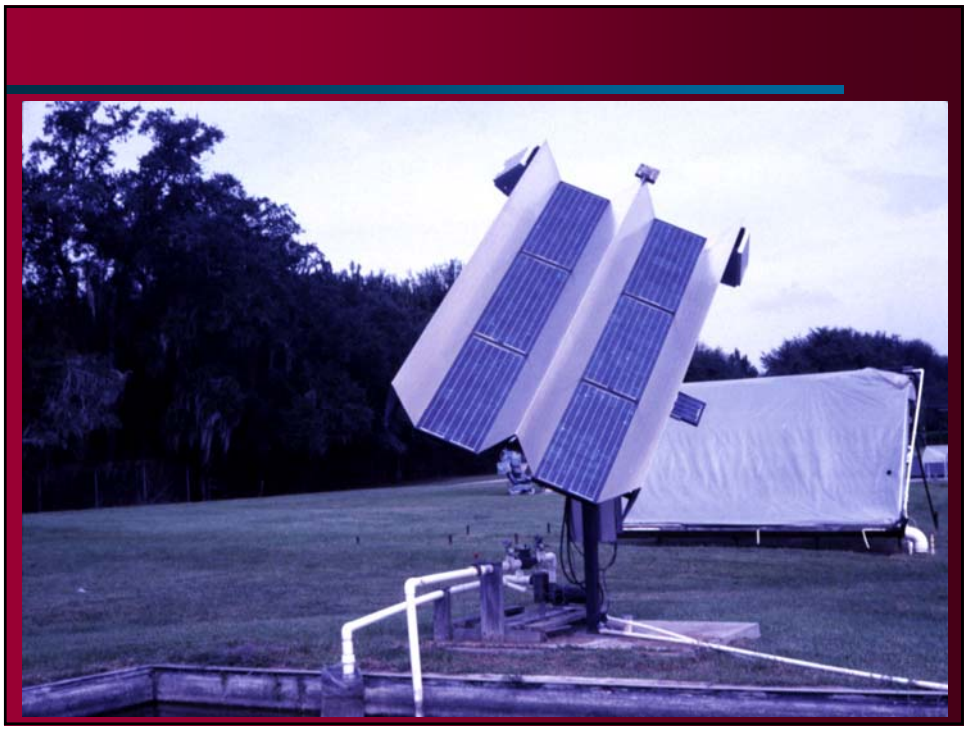
TRANSPORTATION

POWER PLANTS

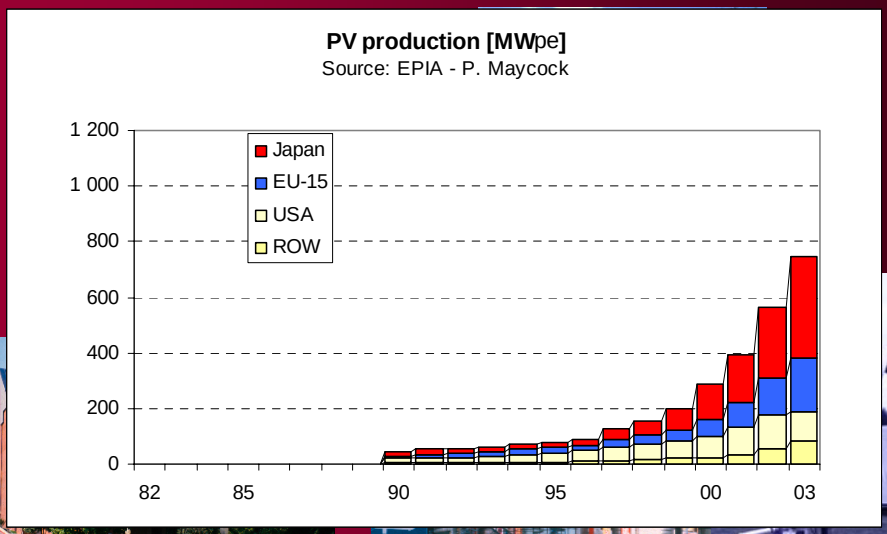
SOLAR ENERGY APPLICATIONS

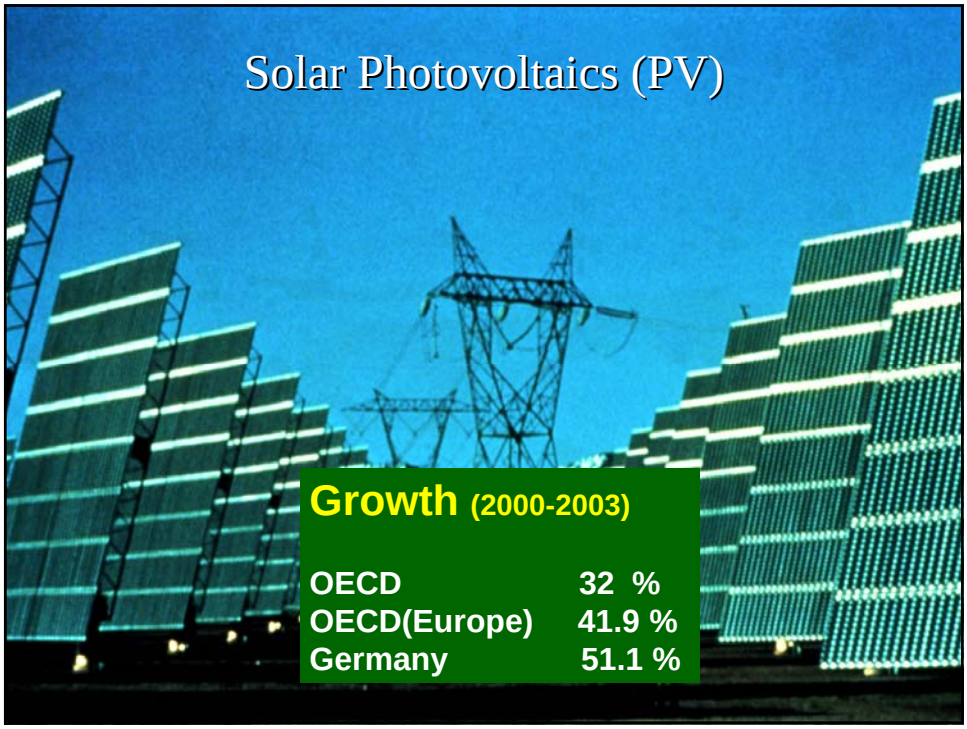
- WATER HEATING
- SPACE HEATING (ACTIVE & PASSIVE)
- INDUSTRIAL PROCESS HEAT
- AIR CONDITIONING (ACTIVE & PASSIVE)
- ELECTRICAL POWER
  - SMALL CAPACITY - PHOTOVOLTAICS
  - LARGE CAPACITY - SOLAR THERMAL POWER
- SOLAR DETOXIFICATION

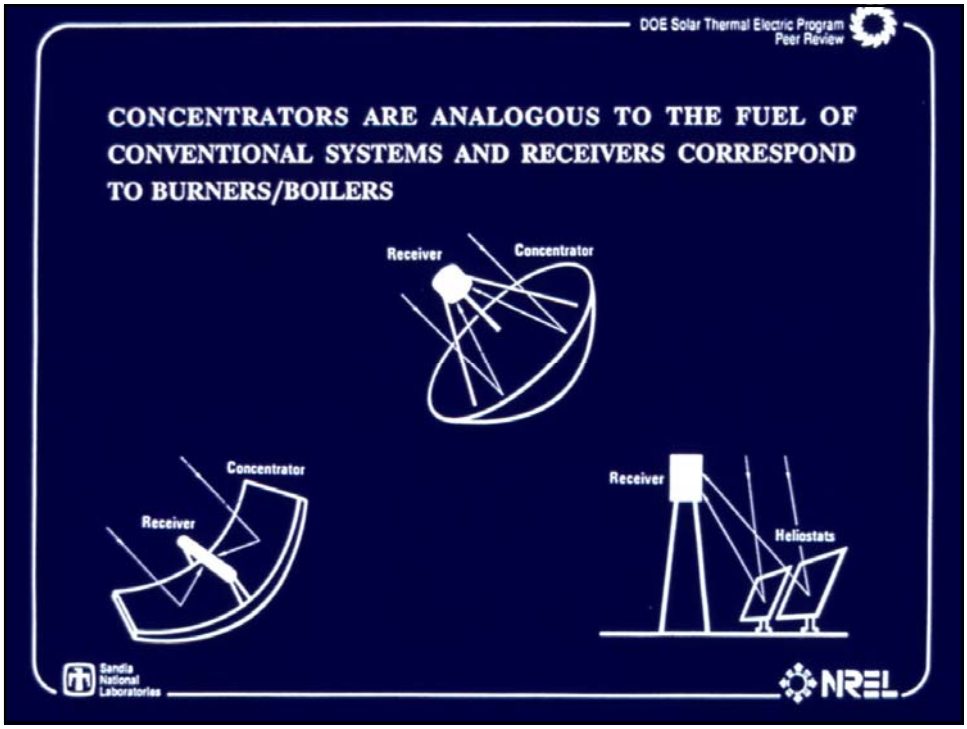


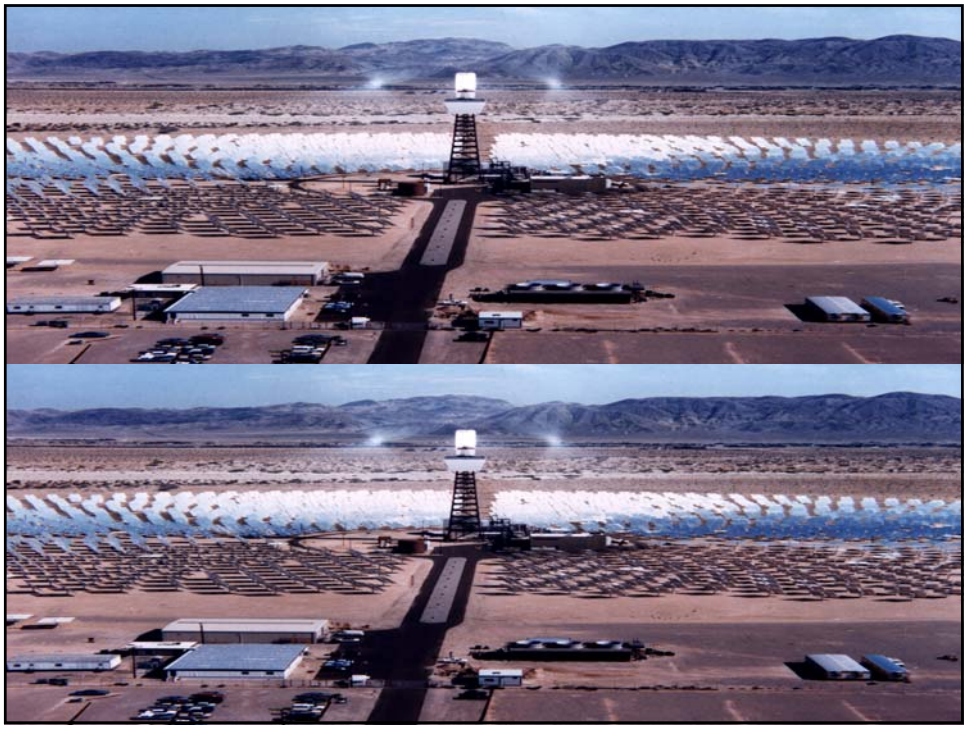


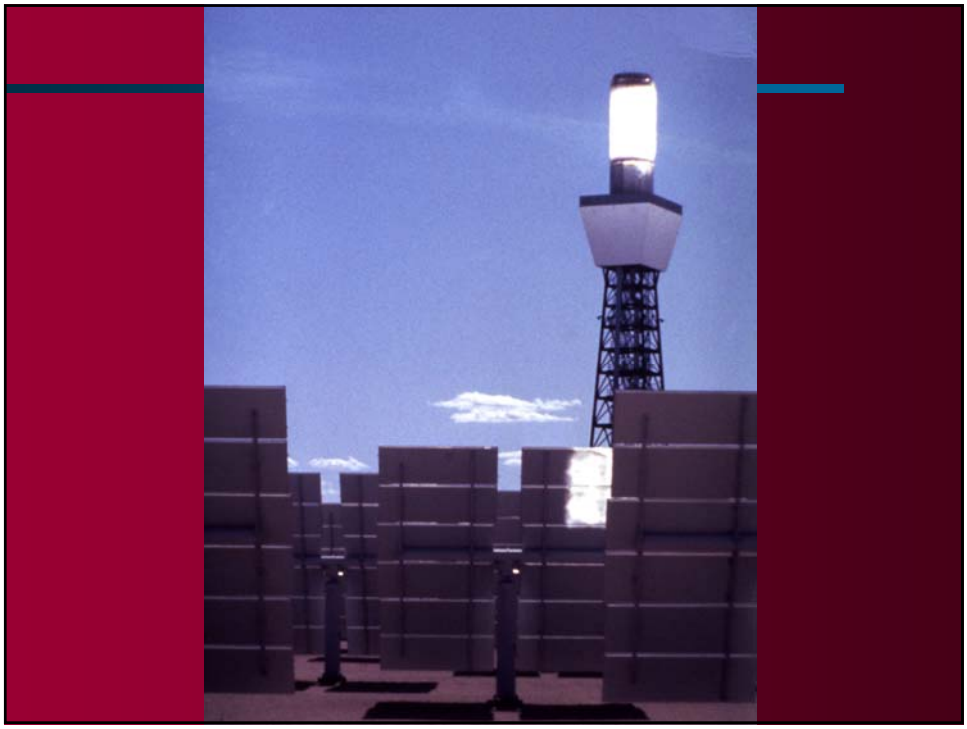
Solar Photovoltaics (PV)

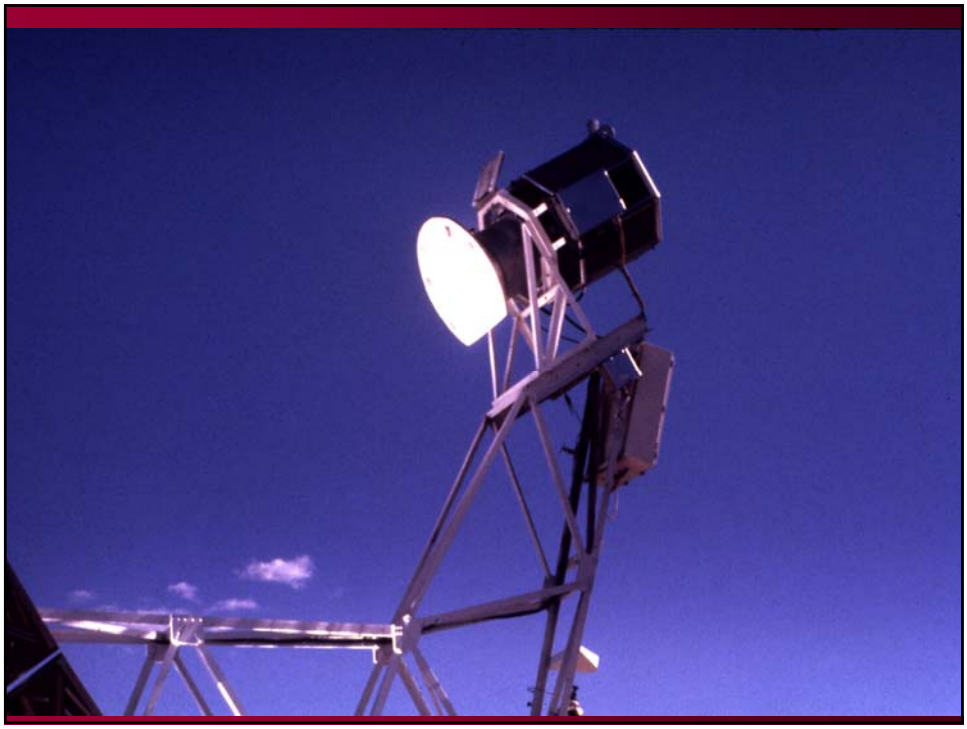


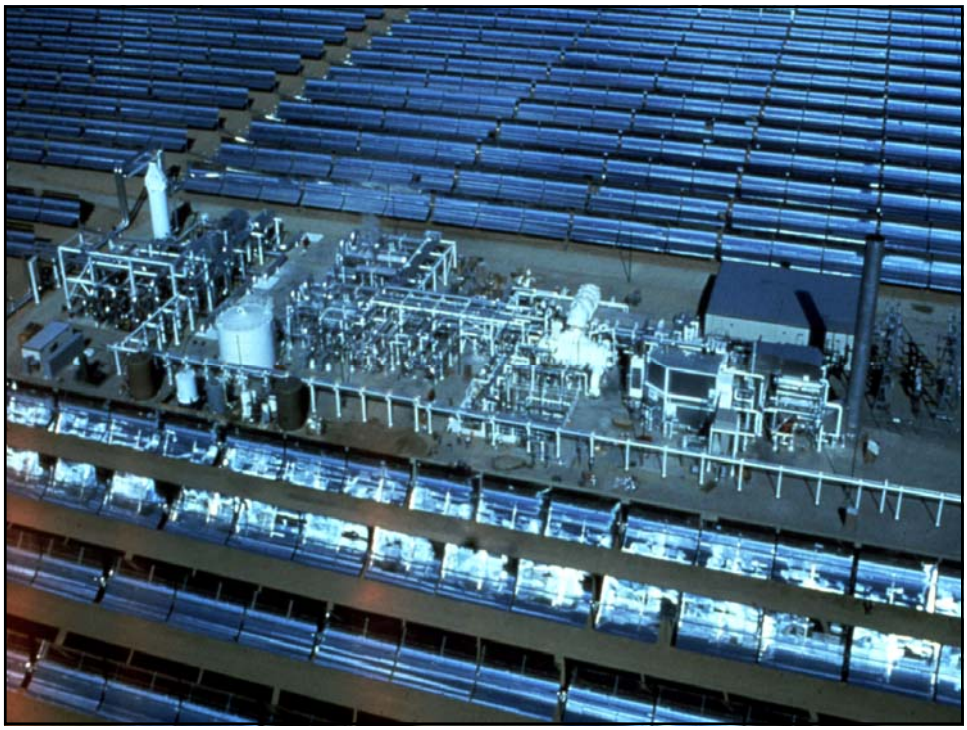

Solar Photovoltaics (PV)
Growth (2000-2003)
OECD 32 %
OECD(Europe) 41.9 %
Germany 51.1 %

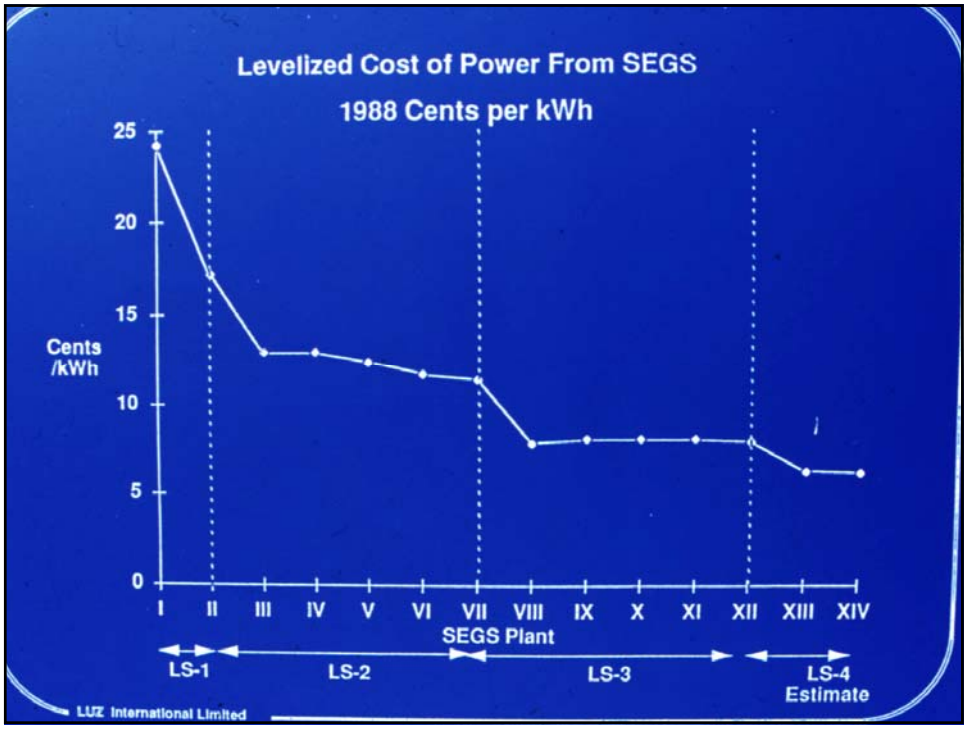

DOE Solar Thermal Electric Program
Peer Review
CONCENTRATORS ARE ANALOGOUS TO THE FUEL OF CONVENTIONAL SYSTEMS AND RECEIVERS CORRESPOND TO BURNERS/BOILERS
Receiver
Concentrator
Concentrator
Receiver
Receiver
Heliostats
Sandia National Laboratories
NREL



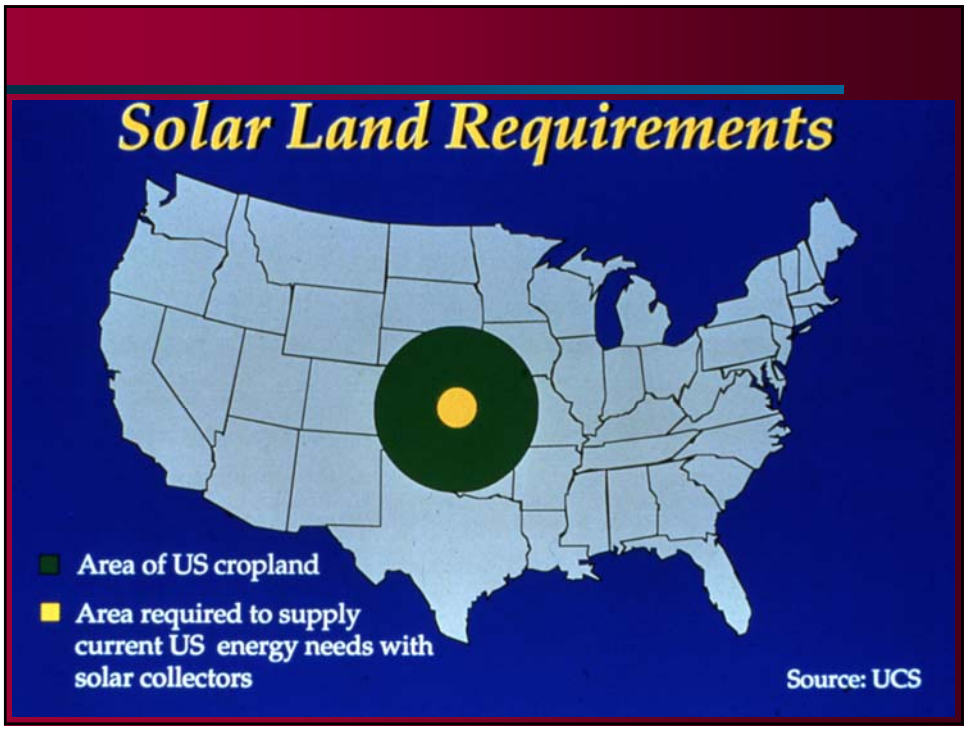


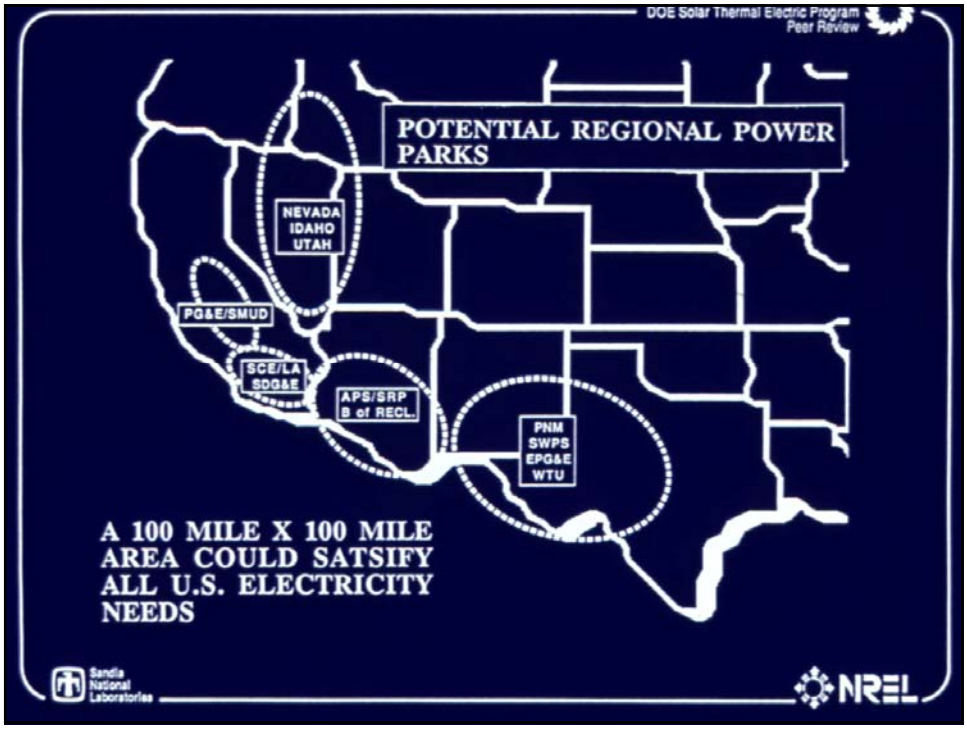





Levelized Cost of Power From SEGS
1988 Cents per kWh
Cents /kWh
25
20
15
10
5
0
I II III IV V VI VII VIII IX X XI XII XIII XIV
SEGS Plant
LS-1
LS-2
LS-3
LS-4 Estimate
LUZ International Limited


Land Area?


Solar Land Requirements
Area of US cropland
Area required to supply current US energy needs with solar collectors
Source: UCS



Solar Land Area Requirements

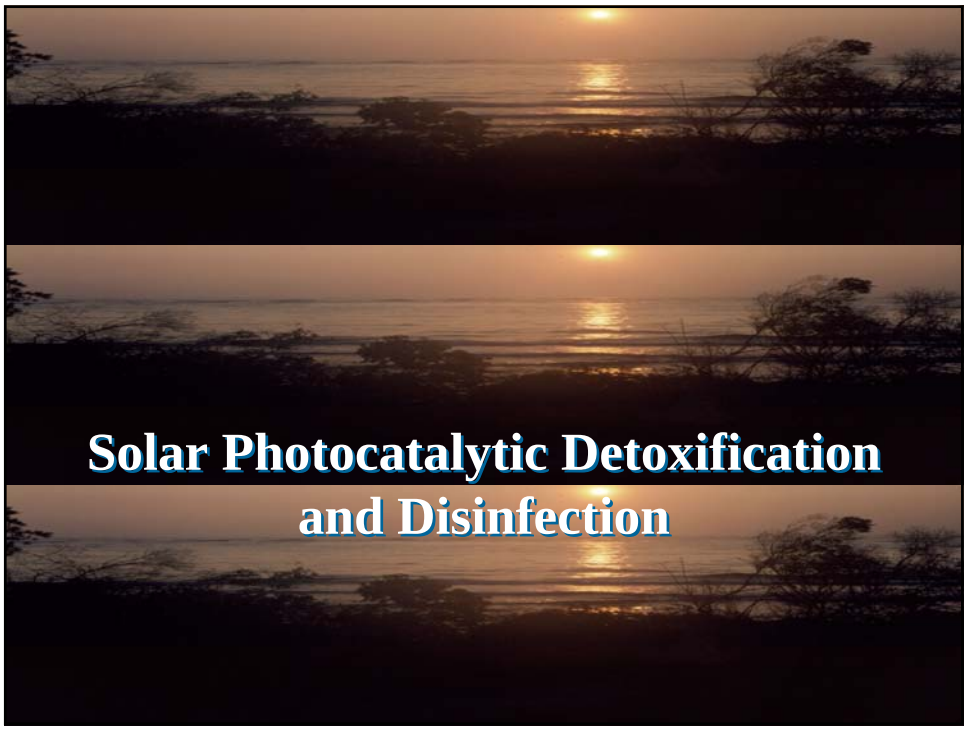
6 Boxes at 3.3 TW Each

Cost?

CAPITAL COST OF POWER TECHNOLOGIES

PHOTOVOLTAICS	$5,000 - $10,000/kW
SOLAR THERMAL	$2000 - $3,500/kW
WIND TURBINES	$1,000 - 1,500/kW
COAL THERMAL POWER	$1,200 - 2,000/kW
COMBUSTION TURBINES	$700/kW


NEW AND EXCITING DEVEOPMENTS
ON THE HORIZON
Dramatic Potential to Reduce Costs:
• New Thermodynamic Power Cycles (50% Potential Reduction in Cost of Solar Power)
• Antennae Based Solar Electric Power (Over 80% Efficiency Potential)


Solar Photocatalytic Detoxification
and Disinfection

Examples of Applications:

- Groundwater contaminated by:
  - Petroleum
  - Pesticides
  - Solvents, etc.
- Industrial Wastewater
  - Textiles
  - Pulp and Paper
  - Pharmaceutical etc.
- Contaminated Air Emissions